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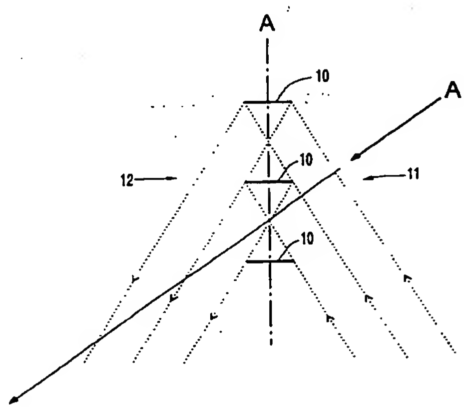

(57) Abstract

An optical reflector is formed by an array of reflecting surfaces arranged one behind another in spaced, generally parallel, relation along a main axis of the array. The reflector has entry and exit faces (11, 12) disposed on opposite sides of, and extending along, the array main axis. The spaces between the reflecting surfaces is preferably occupied by a refractive material. In this case, light entering through the entry face (11) is first refracted and then reflected before being refracted again on leaving through the exit face (12). The main extent of the reflector is unlike a conventional mirror, normal to the plane of reflection. The reflector is thus well suited for use as a vehicle external rearview mirror as it has minimal lateral protection. A reflector array may be produced from a stack of elongate elements having optically worked faces.

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AN OPTICAL REFLECTOR

The present invention relates to an optical reflector suitable for a wide range of use including, for example, use as an external vehicle rear view mirror.

A conventional reflector, or plane mirror, such as used, for example, as an external rear view mirror of a vehicle, can present problems due to its substantial lateral extent, that is, its extent in the plane of the reflector. Such problems include aerodynamic drag exerted by laterally projecting exterior mirrors. At medium and high speeds, the aerodynamic drag factor may account for up to 80% of the total mechanical energy loss resulting in both increased fuel consumption and noise. Furthermore, although exterior rear-view mirrors are designed to yield under impact, they remain a traffic hazard. Mirror yield is of most benefit in very low speed impacts. In higher speed impacts, whether against another mirror or a pedestrian, mirror inertia plays an important role and considerable damage and/or injury can occur.

It is an object of the present invention to provide an optical reflector. The optical reflector of the present invention is suitable for use as a motor vehicle rear-view mirror, but this example is given without prejudice to the generality of the invention which can also be

applied to a wide range of other uses.

According to one aspect of the present invention, there is provided an optical reflector having a plurality of elongate elemental reflectors in an array spaced from one another in a direction generally parallel to the optical axis of each individually elemental reflector whereby to provide a composite image of an object viewed from at least a limited range of angles to one side of the array.

The elemental reflecting surfaces may all lie generally parallel to one another, in which case the optical axis of the reflector as a whole will be parallel to the optical axis of the individual elemental reflecting surfaces.

With such an arrangement, the main extent of the optical reflector is generally parallel to the optical axis of the reflector array (this being normal to the plane of reflection of the elemental reflecting surfaces) which facilitates the use of the reflector in applications such as for a vehicle rear view mirror.

Preferably, the spaces between the reflecting surfaces are at least partially occupied with refractive material whereby light entering through said entry face is first refracted before reflection at said reflecting surfaces

with the reflected light being refracted again before emerging. The means defining the reflecting surfaces may be constituted by a body of refractive material having surfaces providing said elemental reflecting surfaces and with sides that constitute entry and exit faces.

The refraction caused by the refractive material makes it possible to render the reflecting surfaces reflective by backing them with a medium of lower refractive index than that of the refractive material so that reflection occurs by total internal reflection (TIR). Preferably the refractive material is chosen such that the aforesaid medium of lower refractive index may be air.

Embodiments of the reflector may be formed in which, at least one of the entry and exit faces is provided with slots in the refractive-material body, these slots extending towards the opposite face and being so arranged that one surface of each slot constitutes a respective one of the said surfaces.

The body of refractive material can either be formed in one piece or can be assembled from a plurality of elements each of which provides a respective one of the reflecting surfaces. In this latter case a stacked array of strips of transparent material constitutes the simplest embodiment.

The size and/or inclination of the elemental reflecting surfaces may vary progressively along the array of reflecting surfaces. Furthermore, the axis of the array may be curved to enhance the viewing of close objects.

Preferably, the entry and/or exit faces on the refractive-material body has a respective elemental refractor facet associated with each said reflecting surface, each such facet being angled to the main axis of the array such as to modify the optical characteristics of the reflector. The physical parameters of the elemental refractor facet may be such that they vary progressively along the array.

The optical reflector can be combined with one or more refracting devices positioned across the entry and/or exit faces of the reflector to provide an optical reflector assembly having particular characteristics. Preferably, one surface of the refracting device is provided with multiple refracting faces. Where the optical reflector is formed by a refractive-material body provided with slots along one face, then the said one surface of the refracting device may be disposed adjacent to, and facing towards, the face of the reflector provided with the slots. As a result of this arrangement, the elemental reflecting and refracting surfaces of the overall assembly are internal of the assembly.

Light absorbing surfaces may provide to absorb light which is not subject to the intended reflection and, where applicable, refraction.

The optical reflector can, with advantage, be used as a vehicle external rear-view mirror and to this end, the reflector can be provided with appropriate means for attaching it to a vehicle. Alternatively, it may be formed as part of a vehicle. Where the reflector is used as an external rear-view mirror on a vehicle, the array of reflecting surfaces will extend generally along the vehicle. Preferably, the end of the array nearer the front of the vehicle lies further from the longitudinal centre line of the vehicle than the end of the array near the vehicle rear. As a result, light at a narrow angle to the vehicle longitudinal axis can reach the forward end of the mirror which is the mirror part that processes this light; light from a wider angle is processed by the portion of the mirror lying nearer the rear of the vehicle. In order to reduce further the external extent of the mirror, the rear part of the mirror can, advantageously, be arranged to lie inside the natural envelope of the vehicle.

According to another aspect of the invention, there is provided a motor vehicle rear-view mirror having a plurality of elongate elemental reflectors in an array spaced from one another in a direction generally parallel

to the optical axis of each individual elemental reflector by a distance of the same order as the width of the elemental reflectors whereby to provide a composite image of an object viewed from at least a limited range of angles to one side of the array.

According to a further aspect of the present invention there is provided an optical reflector comprising a body of refractive material having two opposed faces at least one of which is provided with slots extending towards the other face, each said slot providing a surface that constitutes an elemental reflecting surface at which light approaching the surface through the body may be reflected by total internal reflection, the slots being so disposed that the elemental reflecting surfaces provided thereby, lie one behind another in spaced relationship to form an array extending along the intermediate said first and second faces whereby light entering the reflector at said elemental refracting surfaces, is further refracted as it exits the reflector through the other of said faces.

Various forms of optical reflector embodying the present invention will now be particularly described, by way of non-limiting example, with reference to the accompanying diagrammatic drawings, in which;

Figure 1 illustrates the optical behaviour of light incident upon a first form of optical reflector embodying

the present invention, in which an array of special elemental reflectors are separated by air;

Figure 2 illustrates the optical behaviour of light incident on a second form of optical reflector embodying the present invention, in which an array of spaced elemental reflectors are separated by a refractive material;

Figure 3 illustrates the optical behaviour of light incident on a first implementation of a third form of optical reflector embodying the present invention in which a body of refractive material is slotted to provide an array of spaced elemental reflecting surfaces at which reflection occurs by total internal reflection;

Figure 4 is a diagram similar to Figure 3 but showing a second implementation of the third form of optical reflector;

Figure 5 is a diagram similar to Figure 3 but showing a third implementation of the third form of optical reflector;

Figure 6 is a diagram similar to Figure 3 but showing a fourth implementation of the third form of optical reflector;

Figure 7 is a beam field diagram for optical reflectors embodying the invention in the case of monocular vision;

Figure 8 is a beam field diagram for optical reflectors embodying the invention in the case of binocular vision;

Figure 9 is a beam field diagram showing a preferred mounting alignment of the optical reflector when used as a vehicle rear-view mirror;

Figure 10 is a diagram similar to that of Figure 9 but showing how the vehicle window contour can be adapted to reduce the projection of the optical reflector beyond the natural envelope of the vehicle;

Figure 11 is a diagram similar to that of Figure 9 but with an additional refractor interposed in the beam path;

Figure 12 is a diagram of a first optical assembly in which an implementation of the third form of optical reflector is combined with a refractor;

Figure 13 is a diagram of a second optical assembly in which another implementation of the third form of reflector is combined with another refractor;

Figure 14 is a diagram of a third optical assembly in which a further implementation of the third form of reflector is combined with a further refractor; and

Figure 15 is a schematic view of a further embodiment of the invention suitable for use as a motor vehicle rear-view mirror.

The first form of optical reflector, shown in Figure 1, comprises an array of elemental reflectors 10, constituted, for example, by silvered mirrors. These elemental reflectors are arranged one behind another in spaced, generally parallel relationship along a main axis

of the array. It will be understood that, in Figure 1, the middle one of the three entry rays shown in fact represents two rays, one of which is reflected at the central elemental reflector 10 and the other, an adjacent ray which continues on to the next reflector face.

One side of the array of reflectors constitutes an optical entry face 11 for the reflector whilst the opposite side of the array constitutes an optical exit face. Taking the optical reflector in isolation, the role of the entry and exit faces is interchangeable. As can be seen, a substantial portion of the light entering the reflector through the entry face, undergoes a single reflection before exiting the reflector through the exit face 12.

For distant objects, the image formed by the elemental reflectors of the Figure 1 reflector are compounded by the eye to form a composite image indistinguishable from that produced by a conventional mirror.

It should be noted that the physical size of the elemental reflectors 10 is not critical but a small size, typically less than one millimetre, can in some circumstances produce a subjectively better quality image than a larger size of typically more than five millimetres. This phenomenon is associated with the relative sizes of the elemental reflectors and the

diameter of the pupil of the eye.

When the Figure 1 reflector is viewed at angles other than the optimum or design angle, a proportional of the light from the object viewed is lost to the eye and, more significantly, a proportion of the light that enters the eye does not emanate from the object. In the case of the reflector illustrated in Figure 1, this proportion of spurious light is about 5% for every degree of view angle away from optimum.

Figure 2 shows a second form of optical reflector embodying the present invention. The Figure 2 reflector is similar to that of Figure 1 but now the spaces between the reflectors 10 have been filled by a refractive material in the form of blocks 14 of an acrylic medium. The increased lateral extent of the reflectors 10 in Figure 2 is solely a result of the refraction that occurs as light crosses the air/block interfaces. The phenomenon of refraction is also responsible for an advantageous reduction in the spurious light effect for non-optimum viewing angles to about 2% per degree.

Another consequence of refraction at the entry and exit faces 11, 12 is that, for all practical viewing angles, the angle of incidence of the light at the reflectors 10 is greater than the critical angle for the acrylic medium. This means that the silvered reflectors 10 can

be dispersed with if each acrylic block is backed by air since now refraction will take place by total internal reflection (TIR). It has been found that a satisfactory optical reflector can be made from a stacked array of optically transparent rods or strips, such as glass or an acrylic material, having generally flat parallel faces. The interfaces between two adjacent strips or rods in practice traps a small amount of air, which results in the total internal reflection of light incident on the face from within the body of the rod on strip; this occurs even if the contacting faces are optically flat since a very small quantity of air is nevertheless trapped between the two faces. Various implementations of optical reflector relying on TIR are described below with reference to Figures 3 to 6.

In the optical reflector shown in Figure 3, a single block of refractive material 15 (for example, an acrylic material) has two opposed faces 16, 17 that constitute optical entry and exit faces for the reflector. The entry face 16 is formed with a plurality of wedged-shaped slots 18 that extend from the face 16 part of the way through the block 15 towards the face 17. One surface 19 of each slot 18 forms an elemental reflecting surface at which light approaching through the block 15 suffers a total internal reflection. The elemental reflecting surfaces 19 are arranged one behind another in a spaced, generally parallel, relationship to form an array having

a main axis that extends along, and intermediate, the entry and exit faces 16,17 of the block 15.

As in the Figure 2 reflector, a substantial portion of the light incident on the Figure 3 reflector first undergoes refraction at the entry face 16 before being reflected at the reflecting surfaces 19 and undergoing further refraction at the exit face 17.

As can be seen from Figure 3, it is not necessary for the elemental reflecting surfaces 19 to extend the full width of the block 15 nor for the refracting interfaces to be up against the end of the reflecting surfaces 19 (see the exit face 17 in Figure 3). It should be noted that the rays shown in Figure 3 and subsequent Figures are typical rays rather than limit rays, this being done in order to facilitate an understanding of the invention.

The optical reflector shown in Figure 4 is similar to that of Figure 3 but in this case the wedge-shaped slots 18 are formed in the exit face 17 of the block 15. In addition, the exit face 17 has been configured such that the elemental refractive facet 20 associated with each respective elemental reflecting surface 19 lies at an angle to the general direction of extent of the exit face 17. The angling chosen for each refractive facet 20 is such as to impart desired optical characteristics to the optical reflector, such as modifying image size.

The optical reflector shown in Figure 5 is similar to that of Figure 4. However, in this case, not only has the exit face of the block been configured to provide angled refracting facets 20, but the entry face 16 has been similarly configured to provide refracting facets 21.

The required profiles of the optical reflectors of Figures 3,4 and 5 can, in principle, be produced by a number of different processes including, for example, where thermoplastic materials are involved, by injection and by compression moulding. Furthermore, as the profiles of the block 15 will generally be linear normal to the plane of the Figures, the desired profiles can be formed by rolling or turning processes.

The attractions of such rotary processes include relatively low cost of tooling and economic manufacture by a continuous flow type of production line.

Although forming the reflector block 15 in one piece from sheet material is generally to be preferred, other ways of constructing the reflectors are possible. Thus, for example, reflectors of the general form shown in Figures 3,4 and 5 could be formed from discrete components as is illustrated in Figure 6. More particularly, the Figure 6 reflector c mprises a plurality of refractive-material elemental blocks 22 fastened together (for example, at

their ends) into the illustrated configuration with one surface of each block 22 providing an elemental reflecting surface 23. As with the reflector of Figure 5, the Figure 6 reflector has angled refractive facets 24 and 25 on both the entry and exit sides 26, 27 of the reflector.

The optical properties of the reflectors described above will now be discussed with reference to Figures 7 and 8. The principle difference in operation between the described optical reflectors and that of a conventional mirror is the behaviour of the object beam; the object beam is the ray pattern obtained on the object side of the reflector by tracing rays backwards from the eye(s) to the object. Figure 7 illustrates the behaviour of the object beam for monocular vision while Figure 8 demonstrates the same behaviour for binocular vision; in both cases the optical reflector of the invention is reference 30.

For distant objects, all the ray angles are the same as for a conventional mirror and viewing takes place normally. For nearer objects, however, some eye accommodation is required. This accommodation is in two forms, namely eye focus for each eye individually, and eye alignment for one eye related to the other.

Focusing requirements become significantly different from

those of a conventional mirror only for very close objects, when the ray path length is considerably less than one metre, and so may be neglected for most applications including vehicle rear vision systems.

Alignment of the eyes, which is favourably parallel for distant objects, needs to be made to diverge for binocular vision of close objects, and this is not a natural action of human eyes. However, the amount of divergence required for objects more than five metres distance is very small, and this is easily accommodated by normal eyes. If binocular vision is required for objects closer than this, then a very small amount of curvature (that is convex towards the observer) may be applied to the optical reflector 30, typically a radius of curvature of a few tens of metres; this will obviate the need for the eyes to diverge at all.

Larger curvature, of the order of one metre radius, may be used in conjunction with progressively changing values of one or more physical parameters of the elemental reflecting surfaces and/or elemental refractor facets in order to achieve specific optical or physical design characteristics. The physical parameters subject to such alteration may, for example, include the surface/facet dimensions and their inclination. Of course, progressive variation of the physical parameters can be effected independently of any curvature applied to the optical

reflector as a whole.

The described optical reflector can be advantageously used in a variety of applications where significant lateral extent of the reflector in the plane of the reflection is undesirable. One such application is the use of the reflector as an external rear-view mirror for a vehicle. Figures 9 and 10 illustrate use of the optical reflector 30 in such an application. From the earlier Figures it will be noted that narrow angle object rays are processed by the more distant end of the reflector and wide angle ones by the rear end. This characteristic of the reflector has important implications particularly when the reflector is used as a vehicle exterior rear-view mirror. More particularly, as can be seen in Figure 9, the reflector 30 is best disposed at an angle to the longitudinal axis B of the vehicle with its front end 31 further from this axis than its rear end 32 (in Figure 9, the exterior of the vehicle is to the right of the vehicle front side window glass 33, the vehicle illustrated being a right-hand drive vehicle). It will be noted that no part of the reflector 30 protrudes beyond that part of the reflector which reflects the narrowest angle ray; this, of course, is in contrast to a conventional mirror where the majority of the mirror protrudes beyond the part which reflects the narrowest angle ray.

This property of the reflector 30 may be used to obtain an improved view behind the vehicle or it may be used to reduce even further the exterior protrusion of the reflector. This latter possibility is illustrated in Figure 10 where the side window glass 33 is illustrated as having been given a particular inwardly angled form enabling protrusion of the reflector 31 to be minimised while still permitting a view down the side of the vehicle.

With the described reflector, except in the case of symmetry of both physical geometry of the reflector and the entry and exit light beams, optical aberrations are present in the image beam. However, by careful design using design criteria known to persons skilled in the art, these optical aberrations may generally be kept within the bounds of subjective acceptability.

If required, additional refractors may be interposed in either or both of the entry and exit beams to condition further the optics and these refractors may either be of the solid or Fresnel prism type. Thus, for example, Figure 11 illustrates the use a Fresnel prism type refractor 40 interposed in the entry beam for the optical reflector of Figure 10. It will be appreciated that one or more refractors may also be positi ned between the reflector 30 and the observer instead of or as well as the refractor shown in Figure 11. Moreover, conventional

prism refractors may be employed rather than Fresnel prisms. Although such prisms are shown in close proximity to the reflector they could be located spaced therefrom, especially if this facilitates the passage between those of an opening side window.

Design flexibility of the assembly of the optical reflector and one or more additional refract·rs is enhanced not only by the choice of geometry for each additional refractor but also by the material used for the refractor; advantageously, this material may possess a different refractive index and dispersive power from that used for the optical reflector of Figure 2 onwards. Figure 12 illustrates a preferred assembly of optical reflector 41 and an additional refractor 42, the reflector 41 being of the general form illustrated in Figures 3 to 6 in the Figure 12 example, the additional refractor 42 is an object beam refractor and, as can be seen, the refractor is formed with precision refracting facets 43 along one face 44. This face 44 is turned towards the slotted entry face 45 which is also formed with precision, angle refracting facets 46. Although in Figure 12 the reflector 41 and the refractor 42 are shown spaced part, in the final assembly these elements are preferably in contact with each other to form a robust body in which the precision refracting and reflecting surfaces of the assembly lie internally and are protected from abrasion, dust and other potential environmental

damage.

Figure 13 shows another assembly of an optical reflector 15 of the general form shown in Figures 3 to 6, together with an additional image beam refractor 52, the two components being shown in their assembled position. As with the Figure 12 assembly, the arrangement of Figure 13 provides protection for the precision elemental reflecting and refracting surfaces of the assembly.

Figure 14 illustrates an assembly similar to that of Figure 13 but for simplified configurations of optical reflector 51 and image-beam refractor 52.

Figure 15 shows in schematic form a mirror 60 suitable for any application where the field of view is wide, for example, for use in a motor vehicle rear-view mirror. In such an application, because the reflected image may be viewed over a relatively wide angle, typically between 30° and 45°, the angle subtended at the eye by the two opposite edges of a reflector in the forward part of the reflector assembly, which is further from the eye, is rather greater than the angle subtended at the eye by the rearwardly located reflectors. This could result in a broken image if an embodiment such as that shown in Figures 1 and 2 is used for this purpose since constant spacing between reflectors and constant reflector width would allow light to reach the observer from a point

forward of the observer by transmission through the assembly between adjacent reflectors as shown by way of example by the arrow A in Figure 1. It will be appreciated here that in the description of the embodiment of Figure 1 the position of the observer was assumed to be somewhat further to the rear so that in practice light arriving along the path of the arrow A would not reach the observer's eyes; however, if the observer's position was different and had to be, for example, closer to the optical reflector or more forwardly located than previously assumed, then light from the position of arrow A could arrive at the observer's eye and result in a broken image. In order to overcome this potential problem one of two alternative modifications to the reflector arrays of the preceding Figures may be employed, namely the spacing between reflectors may be varied along the length or the array or the width of the reflectors may be different along the length of the array. One example of this latter arrangement is illustrated in Figure 15, where it will be seen that the width of the reflectors 61 increases towards the rear of the array such that no light can reach the observer by direct transmission through the array. Ideally, in the viewing position shown, and considering just two of the reflectors, 61a, 61b of the array, the right hand edge of the reflector 61a furthest from the observer should be in alignment with the left hand edge of the nearer reflector 61b at the observer's

eye. Obviously this is an idealised situation since it does not take into account binocular vision or the fact that the observer's head, and therefore his eyes, do not occupy a fixed location in space but may move around within a limited volume. In fact to accommodate both of these factors a small degree of overlap rather than exact alignment may be tolerable. It will be appreciated, however, that any overlap will result in a certain loss of light through the reflector. In most illumination conditions this is tolerable, and appropriately handled, e.g. by using black surfaces for any non-transmissive or non-reflective faces of the device, will not result in any appreciable problems.

The embodiment of Figure 15 is made from a stacked array of strip-like elements 62 each having two opposite substantially parallel faces 62a, 62b (see inset to Figure 15, which illustrates just one such element) the interface between each of which and the contacting opposite face of the next adjacent element defines the reflector 61 by total internal reflection. The other opposite faces 62c, 62d of the element 62 are not parallel to one another in this embodiment, but rather define a trapezoidal section.. Of course, in other embodiments these faces may indeed be parallel.

For any design using discrete elements with at least two opposite faces parallel, the use of ordinary float glass

offers potential savings in manufacturing complexity. For example, if the float faces are the refractor faces, then only one further face, namely the reflector, needs to be optically worked. Furthermore, designs based on discrete elements having at least one pair of opposing faces parallel are particularly easy to assemble with the necessary accuracy. This may be done, for example, by simply sandwiching the elements between additional sheets of float glass.

It has been found that in practice the aspect ratio, that is the ratio between the optical width of the reflectors and the spacing between reflectors is preferably of the order of 3:2. A practical embodiment employs a stacked array of elements 3mm wide and 2mm thick.

It will be appreciated that the various modifications and additions are possible to the described optical reflectors. Thus, for example, various surfaces of the reflector (and, where provided, any additional refractors) can be blackened - that is, provided with light absorbing coating - in order to reduce the intensity of light rays not passing through the reflector along the desired optical path.

Although the currently intended primary use of the invention relates to reflection of visible light, the term 'optical' is to be understood in a broader sense,

including, for example, infra-red radiation.

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In the embodiment of Figure 11, it will be appreciated that the incident light rays arriving from an object to the rear of the vehicle have been illustrated at a much shallower angle to the longitudinal centreline of the vehicle than the reflected rays which are directed from the reflector 30 towards the observer's eyes. This a

symmetry can be achieved not only by positioning the array of reflectors as a whole, as is shown in Figure 11 but also by appropriate orientation of the individual elemental reflectors within the array. Thus, for example, by appropriate orientation of the elemental reflectors, the light paths of the embodiments of Figures 1 to 8, all of which have been shown symmetrical, could be made asymmetrical to take account of particular conditions, not only for use as a vehicle rear view mirror but for any of the other wide range of uses to which the optical reflector of the present invention may be applied. This asymmetry or "handling" of the entry and exit beams may also be facilitated by the use of refractors on the entry and exit sides of the reflector.

Furthermore, curvature of the reflector array either in a convex or concave sense (towards the observer) may be achieved by appropriate orientation of the element reflectors as well as curvature of the array itself by locating the reflectors in a non-rectilinear line. In this way, it may be arranged that the focal position is not necessarily symmetrical, nor necessarily the same in two planes orthogonal to one another. In other words, it is envisaged that the elemental reflectors may, themselves, be composed of sub-elements each of which may be inclined differently from its neighbour to a given flat plane.

CLAIMS

1. An optical reflector having a plurality of elongate elemental reflectors in an array spaced from one another in a direction generally parallel to the optical axis of each individual elemental reflector whereby to provide a composite image of an object viewed from at least a limited range of angles to one side of the array.

2. An optical reflector according to Claim 1, in that the elemental reflectors are arranged one behind another in a spaced relationship along a first direction, the optical reflector having optical entry and exit faces extending in the said direction whereby light entering through said entry face is subject to reflection at a said elemental reflecting surface before leaving through said exit face.

3. An optical reflector according to Claim 2, wherein the spaces between the reflectors are at least partially occupied by refractive material whereby light entering through said entry face is first refracted before reflection at said reflecting surfaces with the reflected light being subsequently refracted again and leaving through said exit face.

4. An optical reflector according to Claim 3, in which the reflectors are defined at the interfaces between a

stacked array of elongate elements.

5. An optical reflector according to Claim 3 or Claim 4, wherein said means defining reflecting surfaces is constituted by a body of said refractive material having surfaces providing said reflecting surfaces and with sides that constitute said entry and exit faces.

6. An optical reflector according to Claim 5, wherein the reflecting surfaces are rendered reflective by silvering the surfaces.

7. An optical reflector according to Claim 5, wherein the reflecting surfaces are rendered reflective by backing them with a medium of lower refractive index than said refractive material.

8. An optical reflector according to Claim 7, wherein said medium of lower refractive index is air.

9. An optical reflector according to any one of Claims 3 to 8, wherein at least one of said entry and exit faces has slots extending towards the other said face, one surface of each slot constituting a respective one of said reflecting surfaces.

10. An optical reflector according to Claim 9, wherein said body of refractive material is formed in one piece,

said slots being formed either with said body or being provided subsequently.

11. An optical reflector according to any one of Claims 5 to 10, wherein the said body of refractive material comprises a plurality of elements joined together, each element having a surface which provides a respective one of said reflecting surfaces.

12. An optical reflector according to any one of the preceding Claims wherein at least one physical parameter of the said elemental reflecting surface changes progressively along said array.

13. An optical reflector according to any one of the preceding Claims, wherein the said array is curved along its main axis.

14. An optical reflector according to any preceding Claims, wherein the said array is tapered along its main axis.

15. An optical reflector according to any preceding Claims, wherein said entry and/or said exit face has for each said reflecting surface, a respective elemental refractor facet, said elemental refractor facets being angled such as to modify the optical characteristics of the reflector.

16. An optical reflector according to Claim 15, wherein at least one physical parameter of said elemental refractor facets changes progressively along said array.

17. An optical arrangement comprising an optical reflector according to any one of the preceding Claims, and at least one refractor positioned in the light path from an object to the observer via the reflector

18. An optical assembly according to Claim 17 when dependent on Claim 9 wherein one surface of the or each said at least one refractor is provided with multiple refracting faces, the or each refractor being assembled with said reflector such that said one surface of the refractor faces towards a said face of the reflector provided with said slots.

19. An optical assembly according to Claim 18, wherein all the multiple refracting faces of the or each refracting device and all the reflecting surfaces of the reflector are internal to the overall optical assembly.

20. An optical reflector or assembly according to any preceding Claim, wherein light absorbing surfaces are provided to absorb light which is not subject to the intended reflection and/or refraction.

21. An optical reflect r or assembly according to any

preceding claim, in which the spacing between adjacent reflectors varies along the array.

22. A vehicle rear-view mirror comprising an optical reflector or assembly according to any one of the Claims 1 to 19 together with means for attaching the reflector to a vehicle.

23. A vehicle provided with a rear-view mirror according to Claim 20 to 22, in which said array of reflecting surfaces extends generally along the vehicle with the end of the array and/or the end of the refractor nearer the front of the vehicle lying further from the longitudinal centreline of said vehicle than the end of the array or the refractor nearer the vehicle rear.

24. A vehicle provided with a rear-view mirror according to Claim 23 in which the forward end of the refractor lies further from the longitudinal centre line of the vehicle that the rearward end thereof and the forward end of the array of reflecting surfaces lies nearer the longitudinal centre line of the vehicle than the rearward end thereof.

25. A vehicle according to Claim 23, wherein the rear part of the mirror lies inside the natural envelope of said vehicle thereby to minimize the lateral projection of the mirr r beyond said envelope.

26. An optical reflector comprising a body of refractive material having two opposed faces at least one of which is provided with slots extending toward the other face, each said slot providing a surface that constitutes an elemental reflecting surface at which light approaching the surface through the body may be reflected by total internal reflection, the slots being so disposed that the elemental reflecting surfaces provided thereby lie one behind another in spaced relationship to form an array extending along and intermediate said first and second faces whereby light entering the reflector through one said face is refracted at this face before undergoing reflection at one of said elemental reflecting surfaces, and further refracted as it exits the reflector through the other of said faces.

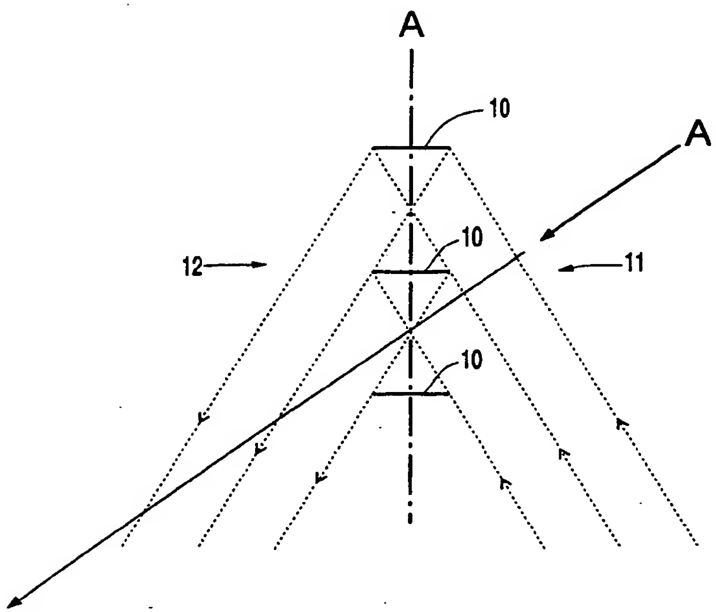


FIG 1

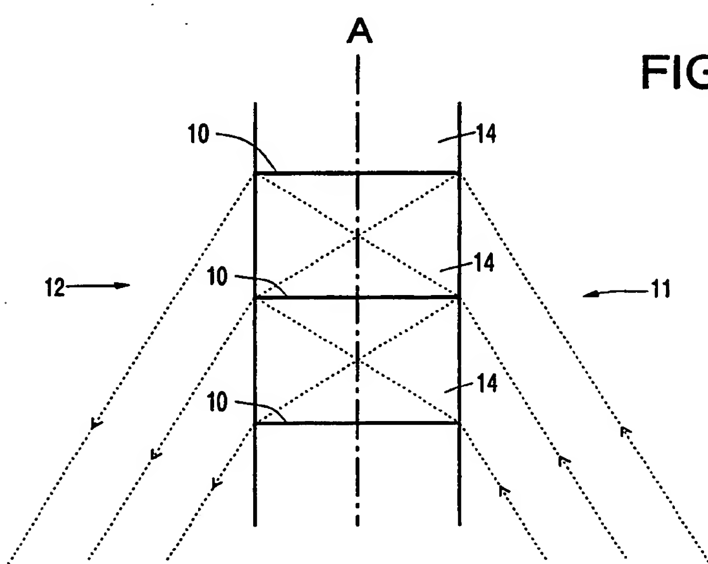
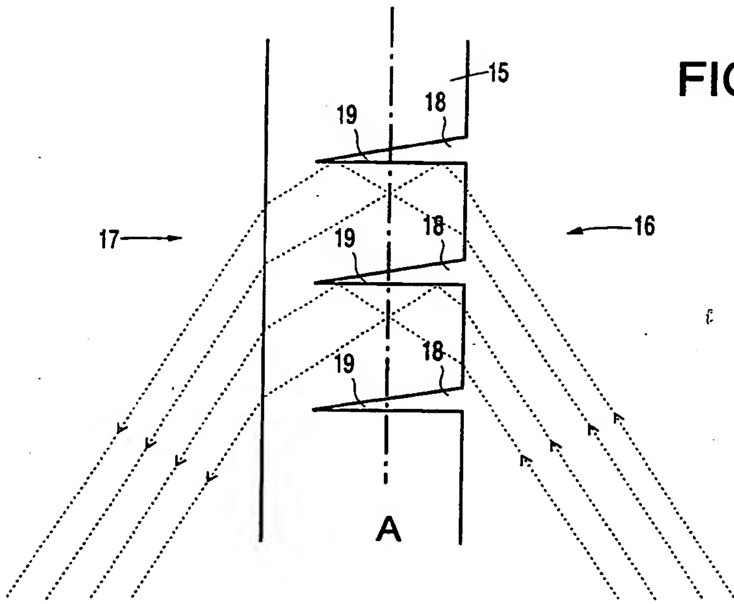


FIG 2



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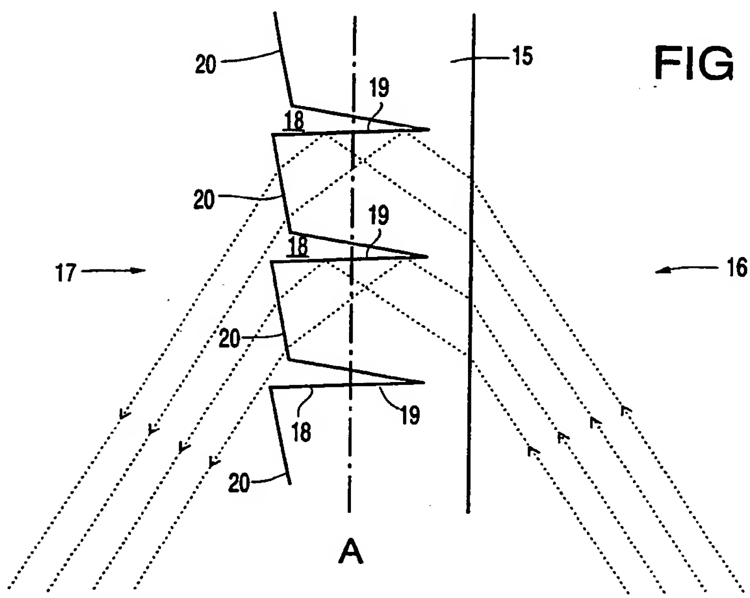

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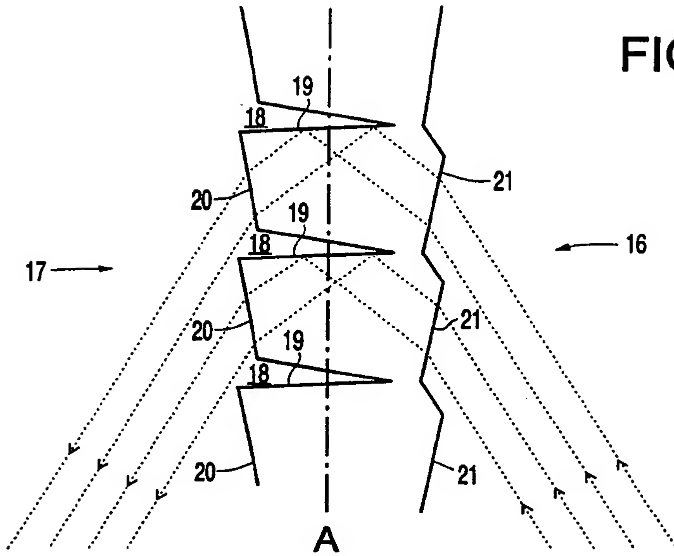
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FIG 5

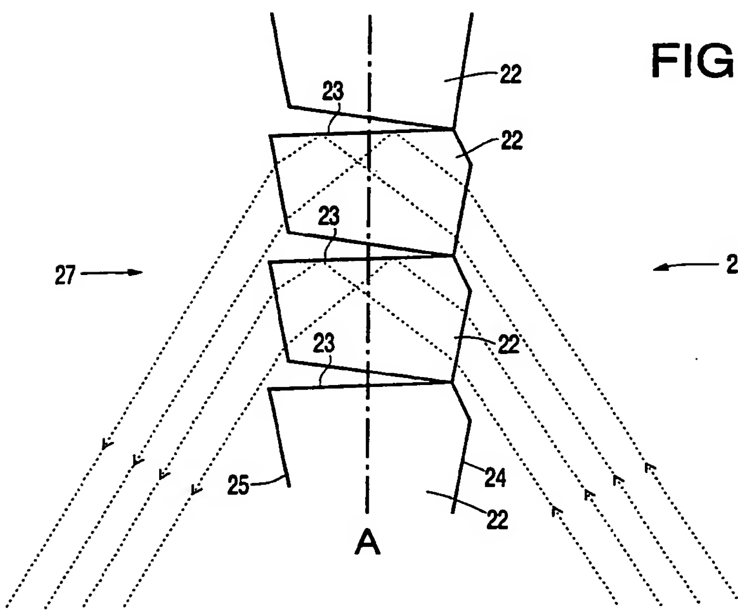
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FIG 6

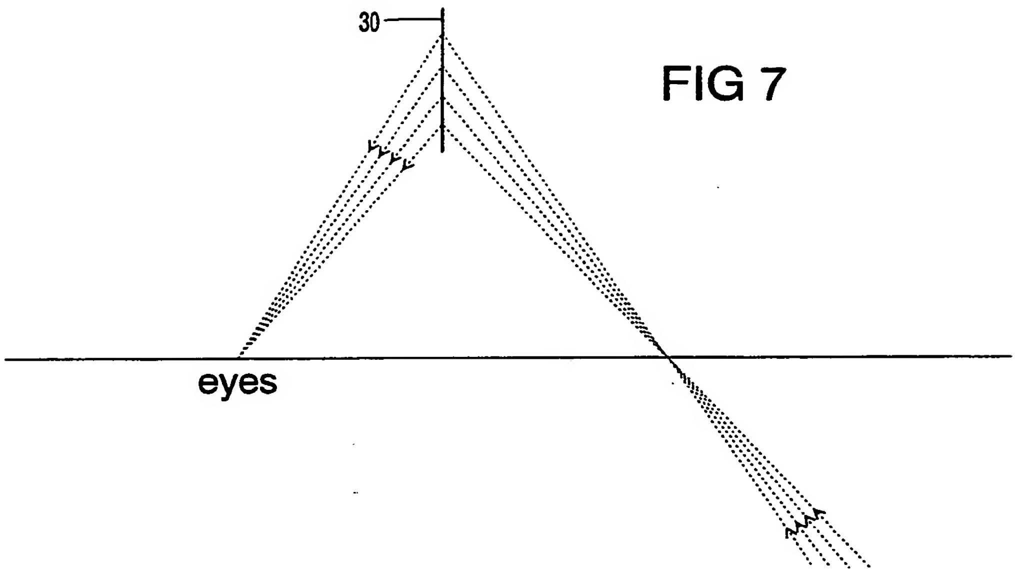

FIG 7

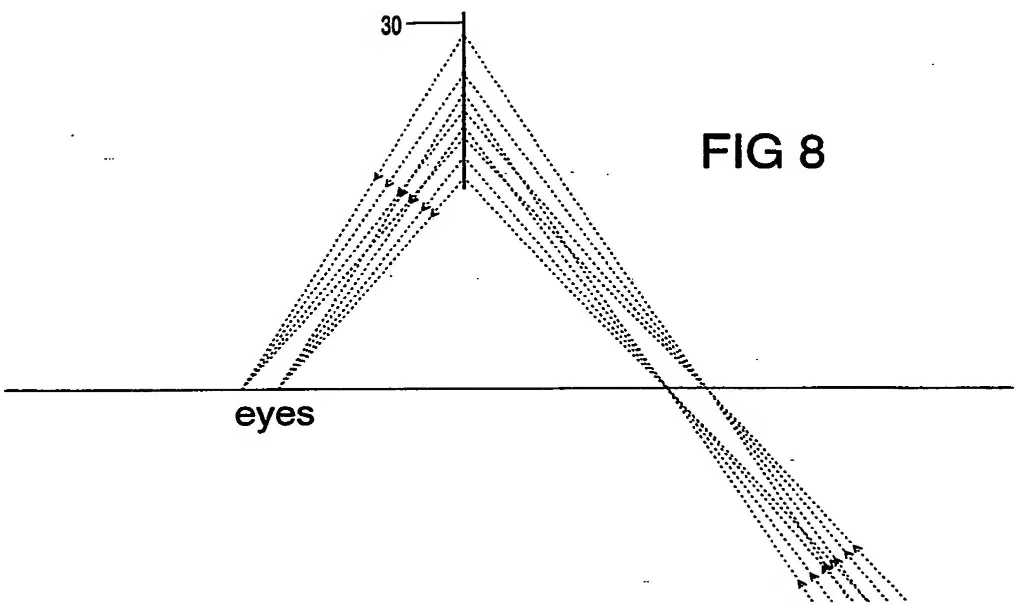

FIG 8

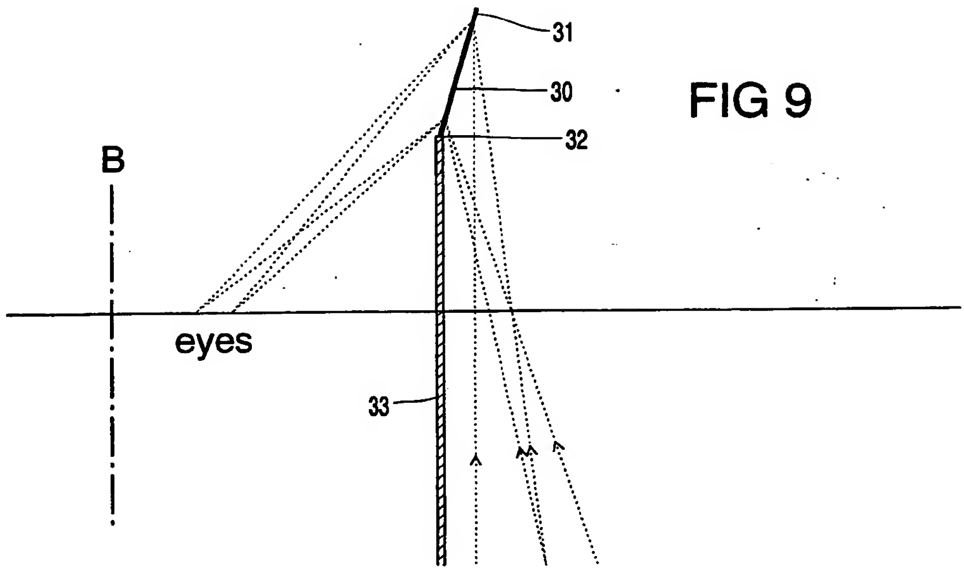

FIG 9

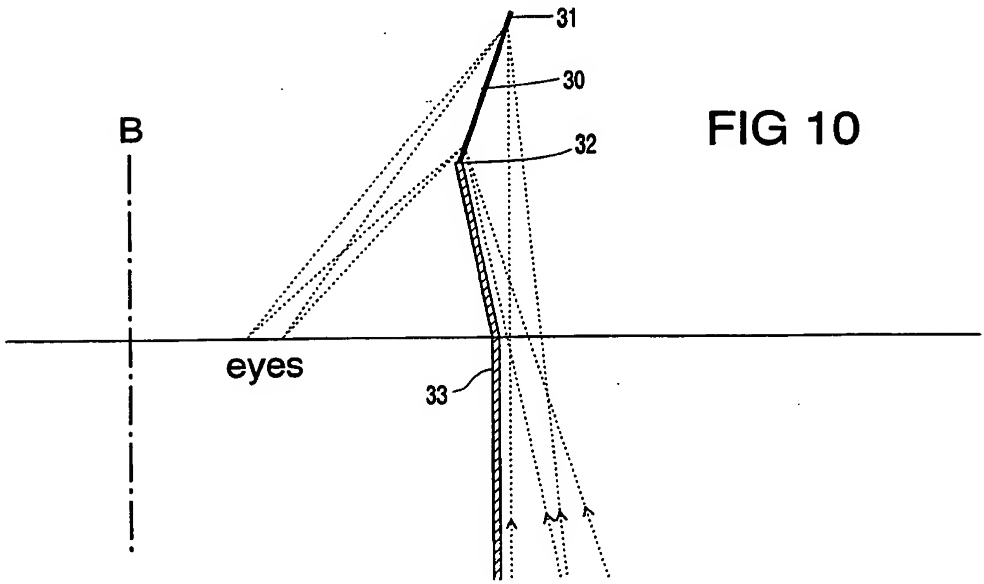

FIG 10

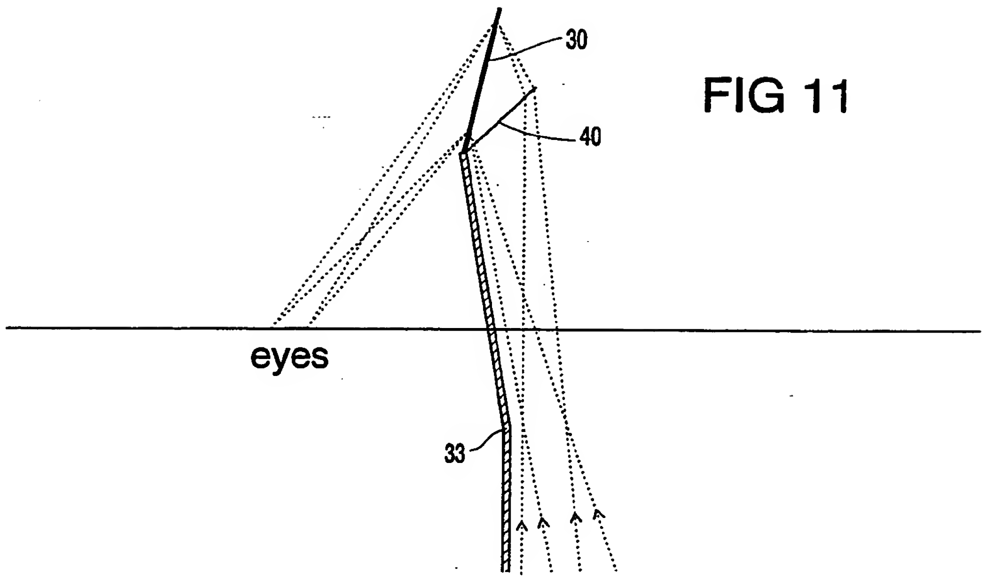

FIG 11

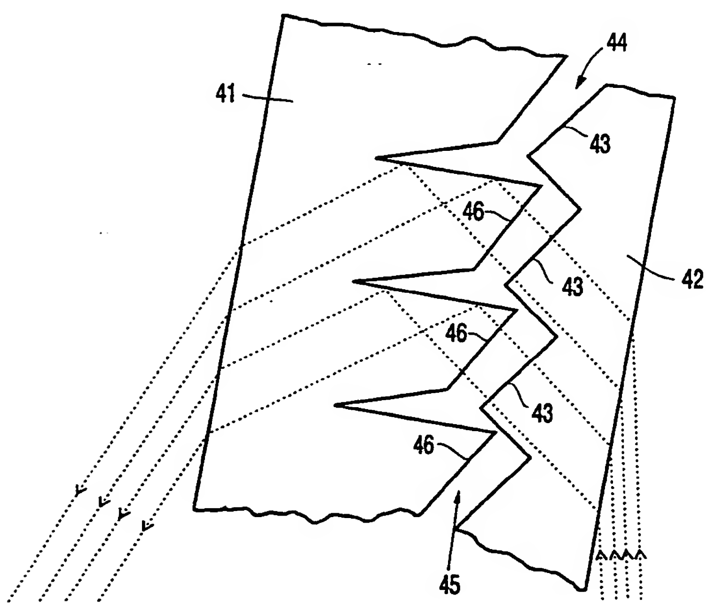

FIG 12

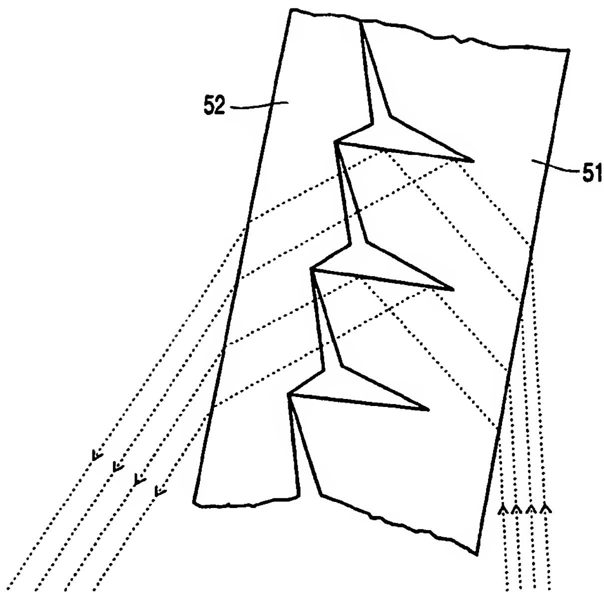

FIG 13

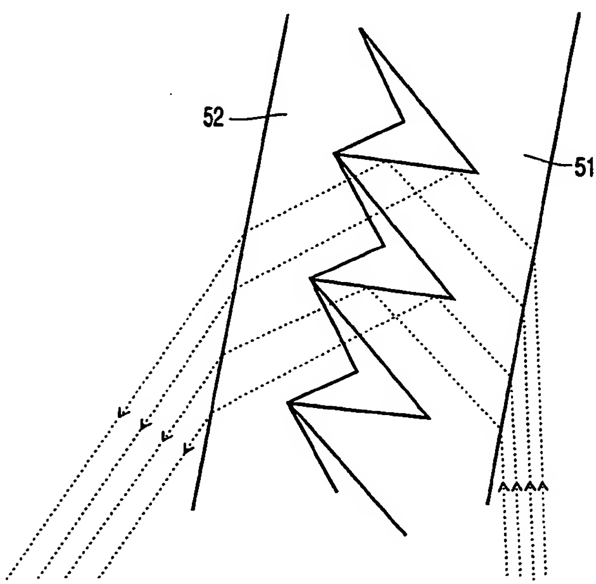

FIG 14

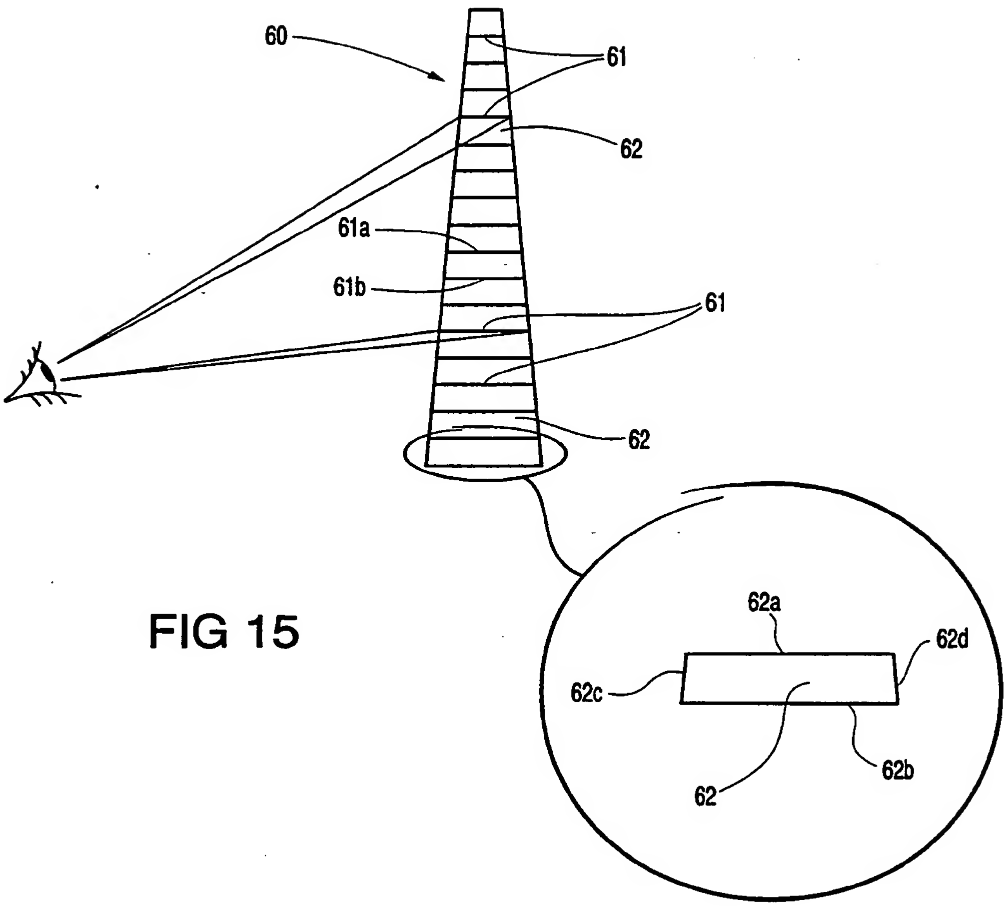

FIG 15

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 92/00945

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B60R1/10

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	B60R ; G02B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	WO,A,9 014 971 (W. H. MEISE) 13 December 1990 see page 5, line 35 - page 10, line 16; figures 4-14	1,22,23
A		2,5,6,10

A	EP,A,0 279 221 (SKF NOVA AB) 24 August 1988 see claim 1; figure 1	1

° Special categories of cited documents : [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
16 JULY 1992	28.08.92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	P. CHLOSTA P. Chlosta

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9200945 SA 59606

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 16/07/92
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9014971	13-12-90	US-A- 4989964	05-02-91
EP-A-0279221	24-08-88	SE-B- 455486 US-A- 4913542	18-07-88 03-04-90

EPO FORM P0479

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82